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ABSTRACT

A group of experts on population projections was convened in Thailand in late 1975. It was organized by the United Nations Economic and Social Commission for Asia and the Pacific. This report is the result of background papers used at the conference, reactions to the papers, and further writing. Chapter headings are: (1) Introduction; (2) The Role of Population Projections; (3) Organization for Making Population Projections; (4) Data Used in Making Projections; (5) Assumptions Used in Making Projections; (6) Computation Procedures Used in Making Projections; (7) Review and Revision of Population Projections; (8) Projections of Fertility; (9) Projections of Mortality; (10) The Use of Demographic Models for Projections; (11) The Use of Socio-Economic Variables in Making Projections; (12) Projections of Subnational Populations; (13) Long-Term Projections for Planning; and (14) Recommendations. (RH)

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REPORT OF THE EXPERT GROUP MEETING ON POPULATION PROJECTIONS

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

Bangkok, Thailand, 1975

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Chapter I

INTRODUCTION

A. Background

1. An Expert Group Meeting on Population Projections was held at Bangkok, Thailand, from 30 September to 6 October 1975. It was organized by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) with the financial support of the United Nations Fund for Population Activities (UNFPA).

2. The Second Asian Population Conference (APC), held at Tokyo in 1972, recommended that development be viewed as an integrated process and that the relationship between economic, social, political and population factors be assessed in all programmes.[1] This view was accepted by the World Population Conference at Bucharest, which emphasized the need to consider population problems within the broader context of socio-economic development. The principal aim of this development, of which population goals and policies are integral parts, is to improve living standards and the quality of life of the people.[2] In the nations of the ESCAP region, these policies are embodied in both short-term and perspective national development plans.

3. Ideally, population projections should play an important part in the planning of every aspect of social and economic development. In actual practice, the extent to which population projections are used varies from country to country depending upon the objectives and the approach to planning. The growth rate of population as well as its future size, composition and distribution are important determinants of employment goals, production targets, and educational objectives as well as of the demand for food, health facilities, housing and other social amenities. On the other hand, achievement in every field of planning for national development affects, directly or indirectly, the growth, size, composition and distribution of future population. Accordingly, those who are charged with planning their nation's social, economic, environmental and demographic future require reliable and detailed long-range projections of population. It was in recognition of this need that the Expert Group Meeting on Population Projections was organized.

1/ *Population Strategy in Asia* (United Nations, Asian Population Study Series No. 28, E/C.N. 11/1152, Bangkok, 1974), p. 66.

2/ *Report of the United Nations World Population Conference, Bucharest, 19-30 August 1974* (United Nations, E/CONF. 60/19, New York, 1975) pp. 6-8.

4. The meeting provided a link in a series of activities, organized by the Population Division of ESCAP, concerning the implications of the growth of population as related to development planning. These include the following meetings held at Bangkok: the Expert Working Group on Population Projections of Sub-national Areas, 14-23 May 1969; the Regional Seminar on the Interrelation between Population and Manpower Problems, 18-30 January 1971; the Regional Seminar on the Ecological Implications of Rural and Urban Population Growth, 25 August to 3 September 1971; the Regional Seminar on Population Aspects of Social Development, 11-20 January 1972; and the Regional Training Course on the Use of Computers for Population Projections, 29 May - 20 June 1973. The aims of these activities were: (a) providing a forum for the exchange of knowledge and experiences on relevant aspects of demographic or population-related problems; (b) giving guidance to member countries in planning and implementing programmes of demographic research and analysis in the context of development planning; and (c) assisting them in the collection of relevant data.

B. Organization of the meeting

5. The specific purpose of this meeting was to provide demographers and planners in the region with a forum for considering the role of population projections in development planning and to discuss the methodological issues involved in the preparation of population projections. The Expert Group was asked to:

a) Review and evaluate work now in progress in the field of population projections, with special emphasis on its relationship to development planning;

b) Develop recommendations and suggest appropriate methodology which would serve to assist in the preparation of population projections required for planning in countries of the ESCAP region;

c) Set forth an agenda of research tasks which could serve as a guide for future ESCAP activities in the field of population projections;

d) Promote an interchange of information and theoretical views between scholars and policy-makers both within and outside the ESCAP region on long-range projections of population.

6. For each agenda item, background information on the current state of the art and on areas requiring further inquiry was presented by a panel of experts. This was followed by discussions and recommendations. The

Chairman of the meeting or, in her absence, the Vice-Chairman acted as the moderator. For each major topic of the work programme, a rapporteur was appointed by the Chairman to assist the general rapporteur. A drafting committee was appointed to prepare the draft report.

7. The participants included 20 experts from 11 member and associate member countries of the Economic and Social Commission for Asia and the Pacific, namely, Australia, Hong Kong, India, Indonesia, Japan, Republic of Korea, New Zealand, Pakistan, Sri Lanka, Thailand and the United States of America. One participant was from Sweden. These experts participated in their individual capacity and not as representatives of their governments, organizations or institutions. Besides ESCAP, staff members from the United Nations Headquarters, the International Labour Organization (ILO), the World Health Organization (WHO) as well as a representative of the Population Council, New York, participated. The list of participants is given in annex II.

8. The meeting of the Expert Group was inaugurated at 9.30 a.m. on 30 September 1975. Mr. Carl M. Frisén, Chief of the Population Division of ESCAP, in his opening address, observed that recent conferences on population had called for achieving replacement levels of fertility in two or three decades or as soon as possible. Implementing such recommendations required both short and long-term planning which considered the interrelationship of demographic, economic and social variables. Implicit in such planning was the role of population projections, and since that role had not yet been appropriately defined, the Group's deliberations on the matter would be most useful. Mr. Frisén urged the Group to examine carefully projection methodologies as related to development plans and to provide ESCAP with guidance in strengthening its programme and its assistance to countries of the ESCAP region.

9. The Expert Group elected the following officers by acclamation: Mrs. Anuri Wanglee as Chairman; Mr. J.R. Rele as First Vice-Chairman; Mr. Dai Young Kim as Second Vice-Chairman; and Mrs. Jeanne Sinquefield as Rapporteur. The drafting committee consisted of Mrs. Anuri Wanglee, Mr. J.R. Rele and Mrs. Jeanne Sinquefield. Mr. K. Kobayashi and Mrs. Jeanne Sinquefield served as resource persons.

10. The following substantive items of the agenda were adopted by the Expert Group:

1. Scope and objectives of the meeting
2. Review and assessment of population projections and their use in development planning in the countries of the ESCAP region

3. Analysis of population projection methodology
4. Illustrative examples of population projection and their applicability to development planning
5. Adoption of the report and recommendations

11. The background documents and working papers listed in annex II were placed before the Group for discussion. Their contents have been integrated into the present text.

12. The draft report of the Expert Group was presented and adopted with some amendments at the conclusion of the meeting on 6 October 1975.

Chapter II

THE ROLE OF POPULATION PROJECTIONS

A. Need for population projections

13. The recent rapid increases in population, which have largely been caused by dramatic declines in death rates, have resulted in a strong and growing interest in the probable size and composition of future population in many countries of the region. As a result, the making of population projections has become an established practice in most of these nations. [3]

14. Population projections serve a variety of purposes, which can be grouped in the following categories: (a) military planning, political representation, and tax revenue estimation; (b) socioeconomic planning; and (c) judging the nature of probable demographic trends. In the past, Governments were interested in population projections mainly for tax, electoral and military purposes. In recent decades, however, Governments are responding to the urgent need for improving the socioeconomic conditions of their people through planned development. This has led to a demand for reliable estimates of the current and future population.

B. Projections required for planning

15. Since all development plans, economic or social, imply a judgement about the size and characteristics of the future population, projections of the size and age structure of the population are now recognized as a minimum requirement for the development planning process. All development plans seek a growth in national income which is in many ways related to population growth and, if targets are set in terms of *per capita* income, then it is necessary to project the future size of population in order to estimate the aggregate level of national income that will be required to meet this target.

16. Planners require various types of projections by sex and age for the nation as a whole and for its regions. Examples of such projections are: (a) total population; (b) labour force population; (c) school age population; (d) population in rural areas; (e) population in urban areas; (f) population in metropolitan areas; and (g) population of different racial or ethnic groups. Also required are projections of households by family size. Among these projections, the national population projection by sex and age is the basic one, because it gives the national total population and its sex-age composition and can be used as a base for calculating other kinds of projections. [4]

3/ *The Determinants and Consequences of Population Trends: Volume I* (United Nations publication, Sales No. E. 71. XIII. 5) pp. 558-570.

4/ For a discussion of the various types of population projections, see *General Principles for National Programmes of Population Projections as Aids to Development Planning*, (United Nations publication, Sales No. 65. XIII. 2) chapter III.

17. Projections of the labour force in conjunction with data on productivity serve as a fundamental starting point for estimates of the future production of goods and services. These projections are also essential for establishing employment targets. Labour force projections in conjunction with educational projections enable planners to take into account changing levels of education, experience and skill of the work force.

18. Population projections are used as the basis for estimating future school enrolment, which in turn is used to plan investments in school buildings, teacher training and production of educational materials. Projections of the future age and sex composition of the population are essential for estimating the incidence and prevalence of various diseases and planning the number of hospitals, hospital beds and specialized facilities, as well as training programmes for medical specialists, paramedical and auxiliary personnel.

19. In planning for industrial development, labour force projections provide a basis for estimating future economic growth, especially in manufacturing and related industries. Projections of manpower, by sex, age, educational level, occupation and industrial sector, may be compared with projections of labour demand to assess probable surpluses and shortages of different types of labour. This will facilitate corrective action through employment or educational programmes. Planners should also use population projections to calculate essential consumer requirements in order to determine the extent to which resources may be diverted away from consumer's goods production to capital formation.

20. Using the nutritional requirements of different age-sex groups, detailed population projections should be used in calculating future food requirements. This in turn will serve as a basis for planning investment in agriculture and related sectors. Projections of the agricultural labour force are needed for planning measures to increase labour productivity and for shifting workers to the other sectors of the economy. Finally, estimates of the potential marketable surplus of agriculture will depend on projections of the agricultural population.

21. Projections of the rate of population growth in both urban and rural areas as well as projections of households or family composition by age, sex and marital status are essential to the process of planning for housing needs by type and size of dwelling. Furthermore, projections of *per capita* income are essential for forecasting the ability of the population to pay for new housing.

22. Planning in many other fields related to particular categories of people, such as requirements for specific types of consumer goods, and various

social services requires projections of the age-sex composition as well as the size of future population. Projections are also widely used for planning in the fields of law and order, energy allocation, and market research.

C. Projections for population policy

23. Measures aimed at modifying future population trends are beginning to be considered as essential parts of national programmes of economic and social development. In such cases, population projections present a demographic profile which may be changed, within limits, by planned action. On the other hand, the demonstration of the possible effects of various types of investment upon the projected population provides an important criteria for investment policy.

24. By directing the attention of politicians and economists to the implications of future demographic trends, population projections play a role in formulating the policies which serve as a basis for development planning. Not only do they generate a concern for the demographic future but they also stimulate action by decision-makers to formulate appropriate policies and programmes designed to alter the rate of population growth.

25. Governments and segments of the public often evaluate the current and probable future growth and distribution patterns of their populations in order to decide whether to attempt particular modifications of the assumed trends via population policies. Calculations illustrating the possible effects of one or several population policy measures can be a part of such a projection exercise. [5]

26. Population projections can highlight the trends or structures that may be expected and thus enable the designing of policies, if necessary, to modify these trends. On the other hand, by taking into account various trends and policies of socio-economic development, projections can illustrate the possible population growth and structural consequences of such presumed developments.

27. Thus population projections are used in two very different types of planning: (a) planning whose objective is to provide services in response to projected population trends; and (b) planning whose objective is to alter population trends to further demographic, economic and social development.

5/ Population policy in this context can be defined to include policy measures which have an intended and direct effect on population trends, as well as policies which might be designed primarily for different purposes but could also have an impact on population trends and structures.

Projections which are designed for use in the first type of planning can be termed "pre-intervention" projections. Projections designed to serve the latter type of planning can be termed "post-intervention."

28. Subnational projections are an essential factor in developing programmes for reducing regional disparities within a country. [6] Projections at subnational levels are particularly useful as a basis for planning transport, communications and electric power systems as well as for planning new industrial towns and rural communities.

6/ Throughout the report, the term "ESCAP region" is used when the reference is international, while the terms "region (s)" and "regional" are used in the sense of areas within a country.

Chapter III

ORGANIZATION FOR MAKING POPULATION PROJECTIONS

A. Scheduling population projections

29. It is important to design regular schedules for preparing population projections of different types. Work on a continuous, rather than an *ad hoc*, basis might stimulate the development of appropriate data, analytical techniques and computational facilities. Furthermore, this would reduce the need for hurried generation of projections in response to sporadic demands of planners. Though *ad hoc* projections are often requested by planners, a scheduled programme should improve the quality of the results by allowing sufficient time to prepare assumptions and baseline estimates.

B. Cooperation between agencies

30. It is also important that there should be close cooperation between agencies producing projections and agencies producing the required statistical data. This is necessary to ensure a high degree of uniformity in statistical concepts, definitions, classification and tabulations in the various series upon which projections are based. This is particularly significant in the case of subnational projections where data from a wide range of sources are being employed.

31. Projections are often made by several agencies either for their own use or on demand from others. Consequently, several alternative projections might be in use by different planning bodies at the same time. This problem could be solved by coordinating the various organizations interested in projections through interdepartmental committees or expert groups. Such bodies could produce a commonly accepted series of projections for use by all planning agencies.

32. The necessity for maintaining consistency between projections of the various sectors and components can be illustrated in a number of fields. Labour force projections should be co-ordinated with school projections and projections of households. Projections of the agricultural labour force should be consistent with projections of the population dependent on agriculture and the rural population.

C. Cooperation between demographers and planners

33. Increased interaction between demographers and planners would serve to improve the quality and utility of population projections; therefore, a regular dialogue between the two groups should be maintained throughout all stages of the development planning process. The planner should inform

the demographer of his detailed requirements. He should specify the time span of the projection, the characteristics of the population such as sex and age groupings, and the geographical coverage of the projection. i.e. national, subnational, metropolitan. Finally, the planner should inform the demographer as to the way the projection would be used, the possible courses of action being considered and development policies and targets that might have an effect on future demographic trends. This information should assist the demographer in formulating a more realistic set of assumptions.

34. The demographer should seek to involve the planner in the formulation of the assumptions to be used in making projections. He should clearly specify the premises under which the projections were made and ensure that they are fully understood by the planners. He should provide planners with data on past trends and discuss with them the plausibility of his assumptions, and the conditions under which each would hold. Finally, the demographer must provide guidance to the planner on the possible demographic implications of alternative development strategies.

35. The demographer and the planner must jointly think through the role which a proposed projection would play in the planning process. In particular, they must assess the consequences that would arise if a projection, used as a prediction, were in error. The implications of both the direction and the degree of the error must be taken into account.

Chapter IV

DATA USED IN MAKING PROJECTIONS

A. Data requirements

36. In countries of the ESCAP region, population projections are normally made using the component method, which involves the projection of the number of males and females in each age group. The application of this method requires reliable information on: (a) the base population distributed by sex and age, usually in five-year age groups; (b) current mortality rates by sex and age; (c) current fertility rates classified by age of mother; and (d) international migration.

37. Estimates of the size and composition of the population and the levels and trends in the components of population growth are usually derived from the data provided by the latest census, vital registration system and sample surveys. Where reliable mortality data are not available, model life tables have been used for determining mortality patterns. Occasionally, data from another country with similar experiences have been used as a substitute when country data are not available.

38. Since age data are usually subject to errors arising from misreporting of ages, corrections or adjustments have to be made in order to obtain a smooth age distribution of the base population. Stable and quasi-stable models as well as model life tables may be used for this purpose. However, corrections or adjustments made with or without the use of these models may not accurately reflect the actual age distribution of the population.

39. The quality of age data in developing countries is closely associated with the level of development and particularly with the level of literacy. An increase in these levels should result in an improvement in the quality of age data, but it may take decades. In the meantime special efforts should be made to improve the quality of age data by setting up experimental projects.

40. Reliable and up-to-date data on mortality trends and patterns are often unavailable. This might in part be due to the fact that the ready availability of model life tables has discouraged further research into mortality in less developed countries and has reduced the funding available for collecting mortality data. Also, greater concern for information on fertility, which is the major determinant of population growth, might have reinforced this neglect.

B. Acquiring additional data

41. The possibility of undertaking quinquennial censuses to supplement data obtained in decennial censuses must be considered in the context of data requirements for population projections. However, additional censuses without qualitative improvements in the data collection process would be of

little value. Furthermore, a census is a massive and expensive operation. Therefore, there must be a more intensive and sophisticated use of sampling procedures to facilitate the collection of current and reliable information needed for making population projections. This effort should also include improvement in the training of interviewers and the framing of more probing questions. Methodological improvements to make better use of existing data are also required.

42. ESCAP has begun to collect computer tapes of public use samples of census data. These data would be useful for estimating rates of fertility, mortality and migration. However, they might not provide a good basis for correcting age distributions and determining base populations. At present in some countries of the region, public use samples of census data are not released because of regulations designed to ensure the confidentiality of the information collected and to protect the individual's right to privacy. Procedures should therefore be developed which would permit the release of the data while at the same time safeguarding individual rights.

C. Need for socioeconomic data

43. Data requirements for preparing population projections are changing in the context of an increasing recognition of the complex relationship between population factors and social and economic development and the concern for integrated development planning. This shift in the need for data should be a major consideration in the determination of topics for future censuses and demographic sample surveys.

44. In recent years several major efforts have been made to relate demographic and economic processes. Often such studies involved an analysis of the relationship between a combination of variables for which data were available in existing censuses and survey reports. The search for the determinants of demographic variables among existing statistical indices is not without merit. However, little progress is likely to be made unless an effort is made to define the type of data required for such an analysis and to ensure that such data are collected through censuses and surveys.

45. In many countries of the ESCAP region, the national census enumeration is accompanied by a sample survey aimed at collecting more detailed information on fertility, economic activity, migration and other demographic and economic phenomena. A more basic integration of demograhic and economic items is, however, necessary. At present, the manner in which sample surveys are organized, executed, compiled and published often results in a separation between demographic and economic factors. For example, in one sample survey, questions were asked with regard to current occupation and place of residence five years earlier, but information on occupation five years previously was not collected. Such information would have made it

possible to analyse patterns of both occupational and geographical mobility, as well as the relationship between the two. Without it, occupational mobility could not be directly examined, nor could it be separated out as a factor in the processes which underlay physical mobility.

46. The correlation of demographic and economic indicators and the use of economic analysis would be facilitated by the long-term development of national integrated systems of demographic, social, manpower and economic statistics and associated indicators. Such systems developed in accordance with international recommendations, but allowing for individual requirements of countries, will assist in providing fully comparable demographic and economic data necessary for a detailed analysis of the interrelationships which determine population change. With respect to each person there should be a small set of basic data such as: sex; age; relation to head of household; income; occupation; industry and level of completed education. All more detailed questions should be derived from samples and mapped on the basic data.

47. The census data for most countries include little retrospective data and no provisions for linking files in time series. As a result, in studies of demographic-economic relationships at the household or individual level, the more subtle relationships are likely to be overshadowed and obscured by relationships attributable to life cycle differences. In addition, the absence of sufficient retrospective data forces the researcher to assume that relationships estimated through cross-sectional analysis approximate those which hold in time series.

48. Many socio-economic demographic projection models have been developed with an implicit acceptance of the limitations imposed by the nature of the available empirical data. But dynamic demographic-economic analysis requires that appropriate analytical models become the basis for the selection of data items collected in censuses and other national surveys.

Chapter V

ASSUMPTIONS USED IN MAKING PROJECTIONS

A. Formulation of assumptions

49. Population projections, to be useful to development planners, must be based on plausible assumptions regarding the future course of fertility, mortality and migration. Yet the difficulty in formulating these assumptions constitutes a weak link in all planning efforts.

50. The formulation of assumptions with regard to the various components of population change is usually conditioned by: (a) the purpose that the projection is intended to serve; (b) the length of the projection period; and (c) the method to be used in making the projection. However, the task will be greatly facilitated by: (a) the availability of precise information about the base population; (b) a knowledge of past demographic trends; (c) an understanding of the various facets of the national history; and (d) detailed studies of the time path of migration, fertility and mortality in other countries of the region. A consideration of the expected achievement of national development programmes will also enhance the realism of the various assumptions.

51. Ideally, projections will be based on relatively accurate knowledge about the population's total number, sex and age structure, and patterns of mortality, fertility and international migration. Knowledge about the past and current demographic dynamics and trends of a country, and an understanding of the important interrelations of economic, social, medical, cultural, educational, political, religious, climatic, and other developments over the years should again be helpful in defining possible future demographic trends.

52. More realistic assumptions regarding the future course of the various components of population change could be made by studying the socio-economic and demographic experience of countries which are similar to the country in question, particularly those countries which have progressed further in developmental terms. The level, rate of change, or the structure of demographic phenomena might be applicable for this purpose. Model demographic "tables" fall into this category. They represent generalized patterns and trends observed in groups of populations, which makes them a natural and often applied tool.

53. The current and planned policies of Governments as well as their major developmental goals and targets can provide additional background material for formulating projection assumptions. The value of such information will depend on the breadth, depth, and time span of the plan, on the stability and efficiency of the respective political and administrative systems, and on the past record of implementation of proclaimed policies.

B. Mortality assumptions

54. Because of uncertainty with regard to future demographic patterns or to illustrate the consequences of alternative trends, demographers usually provide planners with more than one series of projections. These represent different combinations of assumptions with regard to the components of population change. In many cases, alternative assumptions are made with regard to fertility behaviour and a single assumption is made with regard to mortality behaviour.

55. The widespread practice of using only one assumption with regard to mortality is due to: (a) the belief that future age composition is not sensitive to alternative mortality assumptions; (b) the belief that mortality would decline rapidly in the developing countries to levels comparable to those in developed countries; and (c) the paucity of data on mortality trends in developing countries.

56. This practice might not be appropriate in making long term population projections for perspective development planning or assessing the future demographic development. In view of the possibility that there might be severe food shortages accompanied by environmental problems in the future, a wide range of alternative rates of mortality decline should be considered. The sensitivity of population projections to these mortality variants should also be studied.

57. The widely used assumption that the expectation of life at birth would increase annually by a half year or more is inconsistent with the experience of the developed countries. In those nations the rate of mortality decline decreased with lowering levels of mortality.

C. General approaches to making assumptions

58. In the formulation of assumptions, three basic general approaches are used to varying degrees. They may be classified as simple extrapolation, modified extrapolation and subjective extrapolation. Simple extrapolation involves the projection of past trends on the assumption that they will continue in terms of the pattern observed in the past. Modified extrapolation involves projection of past trends with modifications based on analysis of present demographic or related socio-economic factors. Subjective extrapolation involves the projection of trends based on assumptions which appear reasonable to the projector after analysis of past and present trends and allowance for expected future developments.

59. Often assumptions are based on mathematical derivations rather than being meaningfully formulated by demographic analysis. That is, the assumptions are frequently unrealistic from a demographic point of view and only the "medium" projection lies in the realm of the probable. In contrast, development planning requires short-to medium-range forecasts which span

the range of probable population growth and distribution patterns, given the likely effect of alternative government policy options on demographic variables.

60. By presenting only forecasts and assumptions which had already been judged to be reasonable from a demographic viewpoint, planners can be confronted with a choice between population policies rather than with a choice between alternative demographic assumptions. To present population forecasts as a choice between alternative policies leading to alternative population growth and distribution patterns goes well beyond the limits that demographers set for themselves. Nonetheless, judgements on demographic relationships should be made by demographers and demographic-economic analysts rather than by economic planners who are unfamiliar with demographic processes or theory.

61. By formulating assumptions in terms of fertility decline, demographers may redirect the thinking of economic planners away from a concern with the annual rate of population growth and toward a variable, fertility behaviour, which could be monitored during the course of the planning period and serve as a measure of the performance of the population growth policies incorporated in the plan.

Chapter VI

COMPUTATION PROCEDURES USED IN MAKING PROJECTIONS

A. Cohort component methods

62. Given the availability of adequate basic demographic data, the best general purpose approach to making population projections for development planning is the family of cohort component methods which involve the separate projection of mortality, fertility, and migration by age-sex groups. Projections of the age-sex structure are obtained directly and total population is projected by summation. Because it incorporates explicit assumptions regarding the components of population growth, this method gives considerable insight into the way population changes. It provides various summary measures of fertility and mortality. In addition the effects of alternative levels of fertility, mortality and net migration can be evaluated[7].

63. In the cohort component method, a base population is projected forward for a given unit-period by calculating separately the effects of mortality, fertility and migration within each age-sex group. The projected population in each group at the end of the period then becomes the new base population and the process is repeated successively until the calculations are completed for the entire period of the projection.

64. The selection of components will depend heavily on the purpose of the projection. If the main information desired is probable long-term trends of population growth, then relatively aggregated components, such as five-year age-sex groups and corresponding age-specific fertility, mortality and international migration rates will suffice. If the objective is the modification of demographic trends and the exploration of the effects of population planning, it may be necessary to disaggregate the fertility rate by one or several of the following features: socio-economic status, rural/urban residence, education, marital status, use of contraceptives, abortion practice, provision of subsidies, housing conditions and religion.

65. Three techniques may be utilized for the projection of fertility rates as part of the cohort-component method. They are: the period-fertility approach; the cohort-fertility approach and the marriage-parity-interval progression approach. The period-fertility method consists of projecting progressively changing or constant age-of-mother-specific birth rates for successive periods, and then applying the projected schedule of rates to the mean "exposed-to-risk" female populations in each projection time period to determine projected numbers of births. For countries in the ESCAP region,

7/ H.S. Shyrock, and J.S. Siegel, *The Methods and Materials of Demography* (Washington, D.C., U.S. Government Printing Office, 1971), Chapter 24.

the addition of marital status may be desirable in period-fertility projections especially if extra-nuptial fertility is negligible. The major advantage of the period-fertility method is its simplicity. This must be weighed against a number of disadvantages. It does not always yield reasonable projections of family size. And because there is no logical basis for extrapolating fertility trends in period terms, such projections may be without any determining principle.

66. The cohort fertility approach examines trends in fertility for separate birth or marriage cohorts of women, usually in terms of age-specific or duration-specific birth rates, and cumulative and completed fertility rates are derived for these cohorts. In order that the assumption concerning family size will not be unreasonable, fertility assumptions are directly formulated in terms of the completed fertility of real cohorts of women. Extra information, including data on the intentions and expectations of women regarding completed family size, obtained from various surveys, can be utilized in this technique. Historical evidence describing the relationships of cumulative fertility or mean age of childbearing to completed family size is also appropriate.

67. The cohort method of fertility projection may be adapted to take into account marital status. In this method, cumulative fertility rates for women are also calculated and levels of completed fertility assumed, but the rates generally relate to ever-married women. This method also requires that assumptions be made concerning the proportion of women in each birth cohort who will have married by various ages and about their cumulative fertility rates at successive ages during their reproductive period.

68. The cohort-fertility approach has a number of weaknesses. It may be difficult to project the future level of completed fertility within each cohort and the credibility of the method depends on the accurate prediction of this parameter. Birth expectation data obtained from household demographic sample surveys may become unreliable because of a changing family size norm. This may be particularly true for young women who have recently married and not commenced family formation. Projection of completed fertility experience for cohorts as yet unmarried or not in the reproductive ages is hazardous because of the lack of data on intentions. There are additional problems associated with the development of realistic assumptions concerning the timing pattern of births for the various cohorts of women. Like completed fertility, this is a major determinant of total births. Expected total fertility and the timing pattern for cohorts may be projected by mathematical procedures but because of changing social and economic conditions, such an approach may not provide satisfactory results.

69. The marriage-parity-interval progression method involves a greater disaggregation of data and a more realistic structuring of the components. Probabilities of marriage and of giving birth by parity of women are employed in the marriage-parity-interval progression method to determine the number of births of various orders from the number of women who are "exposed-to-risk" of giving birth to a child of a given order. The method operates by means of attrition. The number of single women is reduced by marriage. Childless women are reduced by births. The 1-parity women may become 2-parity women, and so forth.

70. A great quantity of data relating to marriage and child spacing patterns of women is necessary in order to employ this method. While current rates can be obtained from sample surveys or the census, there may be very few guidelines for projection of the relevant parameters. Consequently, this method may be most useful for short-term applications. For purposes of making long-term projections, the merging of the marriage-parity-interval progression and the cohort-fertility method may prove a superior alternative.

71. Mortality may be projected using either a constant or a progressively changing set of age-sex specific death (or survivorship) rates over the projection period. If changing rates are utilized, each age cohort is carried forward, in effect, by a type of generation life table. When satisfactory national data are not available, mortality models, representing generalized schemes for projecting the mortality rates applicable to groups of countries, are employed.

72. Net external migration can be projected either in absolute terms or as a percentage of the base population. The projected age-sex composition should be derived from recent historical migration records. Some adjustments are necessary to age-sex specific net migration figures to allow for mortality, fertility, and aging within the respective cohorts during each projection period. The average period of exposure-to-risk is taken to be one-half of the projection period. Often it is not possible to measure past trends in the volume and age-sex distribution of net migration or predict future trends satisfactorily. In such cases, model tables may be used to measure the effect of any given annual migration level on the age-sex structure of a population. Although based on the migration experience of a single country, models may be applicable to several countries. While the two components of international migration, immigration and emigration, are normally projected in combination as net migration, they can sometimes be projected to greater advantage separately, especially if the age-sex distributions of immigrants and emigrants vary significantly.

B. Projections by single year of age

73. Because demands for projections by specific age groups are increasing, it may be useful to make projections by single year ages. However, due to the lack of accurate base line age distributions and survival ratios by single year ages, it may not be feasible to achieve a smooth progression of cohorts over the years. To avoid this problem, population could be projected by five-year age groups, and then the figures for other specified age groups could be derived by interpolation.

74. Though this approach may be satisfactory for tracing long-range trends, planners often require year-by-year single year of age estimates of the population beginning school, entering the labour force, becoming eligible for military conscription or for old-age or social security benefits. If demographic forecasts are not in a form which directly fills the planners' needs, the demographic component of the sectoral plan often fails to act as a major determinant of the activity schedule. Rather it is "adjusted" to make the plan consistent with other constraints and objectives. This serves to weaken demographic considerations throughout the planning process.

75. Although on-line or off-line interpolation techniques can be used to estimate the population by single calendar years and single-years of age, such techniques may yield internally inconsistent estimates. For example, a given single-year birth cohort, traced through successive years, may show unreasonably large changes or even an absolute increase from one year to the next. Such inconsistencies confront the sectoral planner with the dilemma of either accepting them or making *ad hoc* adjustments. In either case, the planner's respect for demographic guidelines is reduced. Though population projections for single calendar years and one-year age groups are subject to considerable error, they are often required for planning purposes. Therefore, the question resolves itself into a choice between interpolating fertility, mortality and migration parameters and applying the component method by one-year age groups, or making the projection in the standard manner and interpolating the results.

76. The former approach retains a central concept of demography: the birth cohort as the population at risk. Moreover, when model life tables are used to provide the mortality assumptions, the interpolation and use of single-year survival rates is likely to reduce the error arising from applying the five-year survival rates for five-year age groups, based on a hypothetical stationary population distribution, to a non-stationary real population. In any case, the single calendar year, single year of age approach has the advantage of eliminating worrisome and hard-to-explain internal inconsistences.

C. The use of computer programmes

77. The use of the computer in making projections has increased in recent years. However, adequate programmes and other input facilities are often lacking. Frequently, special programmes must be evolved because packaged programmes cannot be used for want of requisite data.

78. There are many computer programmes available for facilitating the preparation of population projections. Among the currently available packages are CENTS, COCENTS, CENT-AID, MINI-TAB, SPSS, FIVFIV, SINSIN, POPPROJ, DCL and UN packages. The relative usefulness of these software packages depends on the methodology used in the programme and the data available for the country concerned. Since many of these programmes are not well known, a comparative study of these packages as applied to different countries should be undertaken. Information on the availability and an evaluation of the alternative computer packages should then be provided to all potential users in a catalogue of such packages.

79. The computer package developed by the Population Council exemplifies a projection model which might be used by countries in the ESCAP region.[8] It includes two programmes, FIVFIV and SINSIN. FIVFIV makes population projections by five-year age groups spaced at five-year intervals using the cohort component method. SINSIN transforms the results of FIVFIV projections into annual estimates of population arranged by single-year or other age-groupings. It also calculates annual social and economic derivatives of population projections on the basis of assumptions provided by the user. The programmes are written in FORTRAN, can run on a small computer, are easily usable by non-computer personnel, and require only those data which would be needed for a standard component method projection. This package has already been applied to making policy decisions concerning transmigration, rural development, family planning programmes and urbanization.

80. FIVFIV and SINSIN have limitations. The data for making population projections in FIVFIV can only be supplied for five-year age classes, and changes in parameters can only be entered at five-year intervals. SINSIN will occasionally produce distributions that are not representative of the actual processes of population change owing to loss of precision in computation and the method of interpolation used.

8/ F. Shorter and D. Pasta *Computational Methods for Population Projections: with Particular Reference to Development Planning*, (New York, Population Council, 1974).

81. The Demographic Computer Library (DCL) is structured around three interrelated operations: life table construction, stable population generation and population projections.[9] At present there are 36 subroutines available with the DCL package. A series of subroutines to adjust and estimate basic data is available. Estimating and generating stable populations are easily accomplished. Population projections can be made for five-year age groups for five-year intervals. The package can be used by an experienced programmer to generate life tables, adjust, smooth and estimate different parameters, such as the age distribution and age-specific fertility rates, and to apply stable population theory in adjusting population data. However, if the user is only interested in making population projections, simpler packages would be more appropriate.

82. The Mini-Tab projection programmes (POPPROJ and FUNCPROJ) were designed for use on computers with small memories.[10] They require no knowledge of computer programming once the programmes are installed. POPPROJ was written to generate population projections by single and five-year age groups for single-year intervals. The programme interpolates five-year base data into data for single years of age. The programme then projects forward one year at a time using data supplied by the user for different single years on fertility, mortality and migration changes. When no changes are indicated, the programme calculates these parameters by linear interpolation. The programme also allows the projections to be made for up to three subgroups of the population. The single-year projections of POPPROJ can be used as input for FUNCPROJ. FUNCPROJ was written to generate functional projections by age, sex and selected age groupings from the output of POPPROJ and user supplied rates such as labour force participation rates.

83. These two programmes are comparable to FIVFIV and SINSIN. The latter have more options concerning the way in which population, migration, mortality and fertility data may be provided, the number of changes in parameters and the projection interval. They also provide procedures for projecting stable and quasi-stable populations; shifting the date of the base

9/ The Demographic Computer Library manual may be obtained from the International Demographic Statistics Center, Population Division, U.S. Bureau of the Census, Washington, D.C.

10/ D. Bogue, "*Techniques for making population projection: how to make age-sex projections by electronic computer*" *University of Chicago Family Planning Research and Evaluation Manual*, No. 12, 1974; and D. Bogue, "*Functional population projections*" *University of Chicago Family Planning Research and Evaluation Manual*, No. 13, 1974.

population; and generating estimates of migration from projections not found in POPPROJ. However, POPPROJ allows changes in parameters for single years, and thus can generate more accurate projections over single calendar years and single years of age than FIVFIV and SINSIN given the requisite data

84. Many developing countries do not have qualified people to use these projection programmes. Efforts should be made to identify organizations and agencies, both inside and outside the region, which might help in training such persons. Various types of short-term and long-term training courses might be utilized for this purpose.

Chapter VII

REVIEW AND REVISION OF POPULATION PROJECTIONS

A. Projections and predictions

85. Population projections are the numerical consequences of a selected set of assumptions. They are, therefore, conditional forecasts which indicate the effect on an existing population base of changes in the various components under carefully stated assumptions over the projection period. As long as the stated assumptions are realized, the population will change in the manner described by the projection. Population forecasts or predictions estimate the most likely future size and structure of the population. Population projections may at times be based on less realistic assumptions simply to demonstrate that some trends are unlikely to eventuate; or they may be normative, analysing strategies by which certain demographic goals could be achieved.

86. Generally, planners tend to treat population projections as predictions. Demographers might reconcile the planner's demand for a single projection with their practice of computing a set of potential trajectories of future population by providing planners with some quantitative guidelines as to the relative likelihood that alternative projections will correspond to the ultimate outcome. The methodology for doing this, however, remains to be developed. The closest approximation to this is the demographer's practice of choosing two sets of assumptions which correspond to the extreme cases (often referred to as the "high" and "low" variants) and one variant in between.

B. Margins of error

87. It can be demonstrated that, at the national level, the margin of potential error between realistic variants of population projections and the one selected as a prediction is a narrow one and within acceptable limits for most purposes of development planning.

88. In the absence of significant net migration over time, a large though progressively decreasing section of the future population consists of survivors of the population present at the base period of the projection. Their size and age/sex distribution are determined solely by mortality. Since moderate changes in the level and pattern of mortality do not significantly affect the size and distribution of the total population, this segment of the population may be referred to as the area of relative certainty. The remainder of the population, whose size and age structure depends primarily on future fertility, may be termed the area of relative uncertainty. It is the

primary source of deviation of the projection from the actual course of events. The range of this error will increase with the length of the projection period but it could be narrowed by assuming changes of fertility, mortality and migration that the demographer feels to be possible in the projection period.

89. The difference between populations projected on the basis of the high and the low fertility assumptions may be termed the possible range of error of population projections. The possible range of error may be expressed as a ratio using either the total population or the population born after the initial period of the projection as a base. The former ratio will be small and increasing. The latter ratio will be larger but relatively constant. The calculation of such relative errors should provide the planner with a quantitative indication of the margin within which he can operate.

90. Though a forecast in terms of a single figure for any point of time will undoubtedly be in error, an assessment of the margin of relative error is possible. To assist planners, demographers should express their opinion as to what they consider to be the most likely population trajectory and its extreme limits. Instead of providing planners with a set of alternative projections, demographers could produce a single forecast, accompanied by an analysis of the sensitivity of that forecast to alternative sets of assumptions.

C. Review and revision

91. Projections used as predictions should never be considered final. They should be reviewed frequently to determine the degree to which they agree with recent demographic events and, in cases of significant discrepancies, whether the divergences between the projection and the ultimate events were due to the quality of input data, the assumptions or the methodology. Such a review should improve the selection of projection models and the formulation of assumptions for future projections.

92. Though it would be desirable to update all projections as frequently as possible, a number of factors should be taken into consideration in determining how often projections should be revised. Such factors will include the performance of the projection, the availability of satisfactory monitoring data, improvement in methodology and the time elapsed since the projection was made.

93. If current data do not suggest that modification of the basic assumptions is required, revision can take the form of adjusting the projections by a ratio or an absolute amount to take into account the observed minor discrepancy. Revision might also take the form of including adjusted projections in the original projection series.

Chapter VIII

PROJECTIONS OF FERTILITY

94. The major source of uncertainty in population projection arises from the difficulty of estimating future fertility. Fertility might be projected either by considering nuptuality the use of family planning programme targets or by taking account of socio-economic variables influencing fertility.

A. Using nuptiality and marital fertility

95. It has been observed in several countries of the region that changes in nuptiality, or age composition, have contributed at least as much to observed declines in the crude birth rate as declines in marital fertility resulting from the use of contraceptive methods. Yet most population projections in developing countries only use age-specific fertility rates. Estimates of future age-specific fertility rates are rarely made by assessing the combined impact on subsequent fertility of changes in marriage patterns and marital fertility rates. Many projections assume changes in the level but not the age pattern of fertility. Since different combinations of changes in marriage patterns and marital fertility rates can result in changes in age patterns of fertility, demographers should take into account both marriage patterns and marital fertility rates in making population projections. A projection technique which incorporates trends in nuptiality, contraceptive behaviour and marital age-specific fertility would provide a more realistic estimate of the future number of births than one which simply used age-specific fertility.

96. A number of procedures are available for using data on marriage patterns and marital fertility rates in estimating future age-specific fertility rates. Coale and Trussel[11] have provided formulas for determining age-specific fertility rates from data on the age structure of the proportion of females ever married and the age structure of "ever married" fertility rates. However, the model schedules do not fit actual experience well when nuptiality is changing rapidly.

97. Alternatively, data on marriage patterns and marital fertility rates may be used in making projections of fertility, with the projection itself determining age-specific fertility rates. Assumptions on changes in marriage patterns and marital fertility rates can be formulated by combining historical data from other countries that have experienced or are experiencing fertility

11/ A. Coale, and T. Trussel, "Model fertility schedules: Variations in the age structure and childbearing in human populations", *Population Index*, April 1974, pp 185-201.

decline with an understanding of recent changes in these two elements within the population of the country being projected.

98. While increasing the data needs for making population projections, this technique is superior in that changes in marriage and marital fertility parameters are easier to conceptualize than changes in age specific fertility rates. It will require more information on the paths to fertility decline that other countries have followed. This points to the need for generating model paths to fertility decline that take into account both changes in marriage patterns and marital fertility rates.

B. Using family planning programme acceptor targets

99. Two alternative methods of fertility projection using contraceptive acceptor targets have been developed by ESCAP.[12] They were designed primarily as an aid in the setting of targets for family planning programmes and the evaluation of the likely demographic trends which would occur if the targets were achieved.

100. These target-setting systems could be of great value to planners. They allow the planner to test the feasibility of various fertility goals within a given resource constraint. Alternatively, they provide the planner with guidance in determining the family planning budget by indicating the magnitude of the change in fertility required in certain age groups to achieve a specified rate of growth of the population.

101. To set realistic acceptor targets, a number of factors have to be taken into account: initial size of population, its age-sex-marital distribution, and mortaliy and marriage trends as well as trends that may affect marital fertility rates independent of programme induced contraception. The principal methodology which has evolved to embrace this large array of factors is component projection expanded to include explicit assumptions about acceptance, continuation and effectiveness of contraception.

102. One such component projection scheme, PROJ 5, is included in the ESCAP methodology. A second system of component projection programmes, labelled ETSS (ESCAP Target Setting System), is also being developed and applied by ESCAP.

103. The interaction of age distribution, mortality and fertility can be handled by means of conventional component projection methods. The

12/ *Some Techniques for Measuring the Impact of Contraception*, (United Nations, Asian Population Studies Series, No. 18, E/CN. 11/1119, Bangkok, 1973) and *The Report of the Multinational Study in Methodologies for Setting Family Planning Targets in the ESCAP Region*, (United Nations, Economic and Social Commission for Asia and the Pacific), (in preparation).

chief methodological challenge is to adjust the marital age-specific fertility rates to reflect the demographic effects of contraception. In PROJ 5, assumptions about acceptance, continuation, and effectiveness of contraception are converted into woman-years of protection. For each age class, woman-years of protection the previous year are multiplied by the users' potential birth rates. The product can be interpreted as births prevented this year. Finally, prevented births are subtracted from the potential births of all married women of the age class. The difference between the two is then divided by all married women of the age class in order to calculate the desired age-specific marital birth rates reflective of contraception.

104. PROJ 5 advances the population one year at a time and encompasses both sexes, but can handle only a single contraceptive method. It can be used to compare a population in the absence of contraception with one subject to a specified single-method regimen of contraception. This pair of projections can be run for any number of years. Programmed for an IBM 360/50, it calls for approximately 60,000 bytes of core. Age specific data are demanded with respect to mortality, proportions married and potential fertility, acceptance and continuation rates.

105. ETSS, like PROJ 5, is a set of computerized component projection programmes. Four of these programmes are designed to handle specific tasks, while five are auxiliary to the others. CONVERSE, which traces the effect on crude birth, death, and growth rates of specified sequences of contraceptive acceptance is the direct counterpart of PROJ 5. TABRAP computes the amount of contraceptive acceptance needed to attain a predesignated demographic goal.

106. The programme entitled TABLE 4 derives births averted for each year, after the year of acceptance of a contraceptive, by annual cohorts of acceptors of that method. The programme, RATIOS, then computes the ratios of births averted after the year of acceptance, when one contraceptive is chosen as standard, to the births averted if other contraceptives are chosen.

107. Unlike PROJ 5, ETSS is limited to projections of no more than 10 years. However, ETSS makes a number of refinements over PROJ 5, and its major advantage is that it is able to handle multiple methods of contraception.

C. Using socio-economic variables

108. Attempts to explain fertility differentials between population aggregates and their variation over time in terms of socio-economic variables

have not been very successful thus far. Therefore, the use of these variables might not result in improved assumptions concerning future fertility.

109. Studies of the association between indices of fertility and social and economic conditions are still inconclusive with regard to the determinants of reproductive behaviour. Also, factors that had been found to be associated with variations in birth rates in a given way at one point in time have not necessarily been associated in the same way over a period of time. Understanding the response of fertility to social and economic changes over time rather than cross-sectionally is necessary if socio-economic variables are to be used in projecting fertility trends.

Chapter IX

PROJECTIONS OF MORTALITY

110. Mortality projections may serve a variety of purposes. They are needed in population projections. They are indispensable for developing and maintaining a social security system. And they are required in the estimation of the probable effects of eliminating certain diseases.

111. Depending upon the availability of required data, various procedures can be used for projecting mortality. These include: time-trend methods, model life table methods and programme approach methods. Each method has its own advantages and disadvantages. Generally, either time-trend methods or the model life table methods are used for projecting mortality. The time-trend methods are more commonly used in the statistically developed countries while the model life table methods are most often used in statistically less developed countries.

112 Time-trend methods are quite flexible and offer a variety of alternatives, *viz.* (a) assuming no further decline in the latest observed death rates, (b) extrapolating past trends in the country's own death rates, (c) applying standard percentage decreases in death rates depending on the death rate at each successive date, and (d) establishing target rates for a distant future date and securing rates for intermediate dates by some form of interpolation. A combination of the above procedures may be used, especially if the projection extends far into the future.

113. Model life table methods are typically applied in two stages. First, mortality is projected in terms of the expectation of life at birth; and second, a model life table with the same life expectancy is selected and its survival ratios are used in the projection of population. Several studies have pointed out the inadequacies of model life tables in depicting the patterns of mortality in the developing countries. Since developing countries make extensive use of model life tables in the projection of mortality, the need for revision of the existing tables is keenly felt. For example, life tables should be adjusted for known special events which influenced mortality levels. Attempts in this direction have already begun under the auspices of ESCAP.[13]

114. The stable model projection procedure consists of two basic steps: constructing a stable population using the available evidence relating to a particular actual population; and assigning the various parameters of the

13/ *Comparative Study of Mortality Trends in ECAFE Countries* (United Nations, Asian Population Studies Series, No. 14, Bangkok, 1974).

derived stable population to the actual population. The value of this technique lies in the fact that the first step can be taken with confidence, even on the basis of fragmentary data, and the second step yields a series of demographic measures for which no direct information exists in the actual population. The weaknesses of the method are twofold. Firstly, the actual situation may be poorly approximated by the stable model. Secondly, even if the true situation is close to a stable state, available data may not be adequate for the derivation of an appropriate stable population. Limited data will be consistent with too broad a range of stable configurations to be of much analytical value.

115. The construction of a stable population directly or indirectly requires the availability of a life table or series of life tables covering a range of mortality experience. While the detailed data required to construct life tables are rarely available when stable estimation techniques need to be used, appropriate tables can be implicitly assumed to represent various levels of mortality.

116. Another limitation of the model is that the growth rate and life table underlying a particular stable population do not determine a unique fertility schedule or gross reproduction rate. Despite these defects, the method has often proved effective, especially in countries lacking comprehensive historical demographic statistics, although improvements in the range and quality of demographic data may tend to reduce the need to apply these techniques in the future.

117. Projections will obviously be much better if they are based on a knowledge of specific programmes, plus information on anticipated changes in the realm of socio-economic development. Although this may be the ideal way to project mortality, it may not be possible to use this approach in some developing countries due to the lack of requisite data.

Chapter X

THE USE OF SOCIO-ECONOMIC-DEMOGRAPHIC MODELS FOR PROJECTIONS

A. The role of models in planning and projections

118. In planning for socio-economic development, all variables whether demographic, social or economic must be considered interdependent. Economic and social changes induce demographic changes just as changes in population partly determine the course of economic and social events. Therefore, it is not sufficient to establish assumptions for projection with regard to one factor at a time or to work with independent assumptions. This points to the need for a co-ordinated handling of all important factors simultaneously through a form of systems analysis. Furthermore, the interrelationships among the sectoral components and socio-economic groupings of the population indicate the need for a co-ordinated system of demographic projections that are consistent with the total population projection by age and sex.

119. Socio-economic-demographic projection models should be capable of illustrating the feedback effect of development plans on demographic variables. For example, planning for housing will depend on projections of household formation, which depends upon rates of nuptiality and migration. These factors, in turn, depend on plans for generating employment opportunities. At present, consideration of this feedback effect of development plans on demographic variables is given in the formulation of assumptions rather than being part of a unified model of socio-economic and demographic development.

B. Alternative models

120. In recent years, two major "global" models have been developed.[14] They may be termed the "Limits to Growth" and "Mankind at the Turning Point" models. The "Limits to Growth" model deals with a limited number of basic factors (population, natural resources, food production, industrial production, capital accumulation, pollution and overcrowding). These factors are aggregated for the world as a whole. There is no division between developed and developing countries. Global averages are used throughout. The "Mankind at the Turning Point" model is disaggregated into ten world regions. World regions 3, 9 and 10 refer to Japan, 16 countries of south and southeast Asia and four centrally planned Asian countries respectively.

14/ D.H. Meadows, D.L., Meadows, J. Randers and W.W. Beherens, *The Limits to Growth*, (New York, Universe Books, 1972) and M. Mesarovic and E., Pestel *Mankind at the Turning Point: the Second Report to the Club of Rome*, (New York, E.P. Dutton, 1974).

The model is also stratified in a hierarchical way into an individual, a group, a demographic-economic, a technological and an environmental level.

121. Although the correctness of the model's structure is open to question, it has already been used for analysing certain problems, such as food and energy, in some Asian regions. However, due to its inadequate treatment of demographic phenomena, its usefulness as an instrument for general forecasting of demographic-social-economic development remains to be seen.

122. A wide variety of other models which may be used for population projection also are being developed. For example, the Demographic Research Institute of Gothenburg, Sweden, is engaged in developing a system of integrated Markov type models. These models are distinguished by a high degree of disaggregation and the fact that model events are governed by stochastic distributions.

123. The BACHUE series of models developed by the International Labour Organisation (ILO) provides a comprehensive general framework which can generate population projections in the context of a comprehensive set of dynamic interrelationships between social, economic and demographic changes.[15] These models were designed to assist policy-makers in taking into account population factors in making employment policy and *vice versa*.

124. The first BACHUE model was a theoretical prototype. BACHUE 2 was designed specifically for the Philippines. It has been used to generate projections covering periods of 10 to 50 years. The labour market and income distribution subsystem is central to the BACHUE model. It treats in detail the links between the industrial structure of employment, dualistic development, and the distribution of income among households. These are areas where demographic changes are likely to have a significant impact and which, in their turn, are likely to significantly effect economic and demographic behaviour.

125. As a result of a dialogue between model builders and policy-makers, the model has been modified in order to make it more useful. Continued effort will be required to obtain data which will be suitable for the model. The BACHUE model is also being applied to other countries to determine whether it can be successfully adapted to the needs of nations at different stages of socio-economic development.

15/ M.J.D. Hopkins, G. B. Rogers and R. Wery, *A Structural Overview of Bachue-Philippines* (International Labor Organization, Population and Employment Working Paper No. 20, WEP 2-21/WP. 20, Geneva, 1975).

126. A number of other computerized models have been developed which generate population projections on the basis of the interaction of demographic, social and economic variables. They include models developed by the United States Bureau of the Census, the United States Agency for International Development, and the Food and Agriculture Organization of the United Nations [16] These models differ widely from one another in their purposes and structural characteristics. Therefore, they would not generate identical projections.

127. Unlike the BACHUE models which are single unified structures requiring a large computer and data base, LRPM is a set of integrated submodels which can be used separately or in combination to generate detailed projections of demographic and related socio-economic variables. These submodels can also be used in analysing demographic data and in preparing the inputs to other models.

128. There are three versions of LRPM in use: LRPM 2, LRPM 3 and LRPM 4. All three may be used to project births, deaths, migration, labour force, education, housing, food requirements and income distribution. LRPM 2 is the simplest model and is designed for use in the least developed countries. It projects flows, such as the number of students graduating, but it does not project stocks, such as the number of high school graduates in the population. LRPM 3 tracks persons by their age and educational level, offers more variations of vital rate parameters and projects stocks as well as flows. LRPM 4 is still more sophisticated in its uses of data and is designed to focus on the agricultural sector.

129. The LRPM models may also be used to prepare data for projections. They can be used to correct census data by projecting forward to the present from an assumed stable population base in the past, using the demographer's best estimates of changes in natality and mortality. Also, since natality and mortality projections are often made independently of one another, a simulation run over time using LRPM can be used to test the credibility of these assumptions taken as a group.

130. The LRPM models were so designed that, when installed on a computer and running, any computer technician should be able to format data as provided by the planners, call and run any of the routines. Thus demographers, economists, and sociologists from various ministries would

16/ J. Quinn, *The Use of the LRPM and PDM Models for Structural Analysis and Development Planning*, (U.S. Bureau of the Census, mimeographed, Washington, D.C., 1975), R Brown and H. Cole, *The TEMPO Model as a Basis* for *Development Planning*, (General Electric Corporation. TEMPO, mimeographed, Washington, D.C., 1975), and W. Linn and M.C. Ottavani-Carra, *A Systems Simulation Approach to Integrated Population and Economic Planning*, (Food and Agriculture Organization, Rome, 1975).

find it easy to make demographic and related projections needed for further work.

C. Advantages and disadvantages of models

131. The use of a socio-economic-demographic model for making projections provides the demographer with a guide for deciding which data items are to be collected in censuses and other national surveys. An additional advantage of such formal models lies in the fact that they make explicit the socio-economic-demographic interrelationships that are implicit in the work of the demographer when he formulates assumptions on fertility, mortality and migration trends. Because they are explicit, it is possible to examine and criticize formal models on the way in which parametric values for demographic and economic variables are estimated; and the manner in which relationships between variables are treated.

132. In a number of these models, the structural relationships have been estimated and tested on the basis of cross-sectional evidence. This is not satisfactory because the models should reflect and allow for the dynamics of development in both socio-economic and demographic variables. In particular, the effect of time lags in the adjustment process must be considered. This is particularly important in complex simulation models such as these because conceptual or statistical weaknesses in component submodels might have adverse cumulative effects on generating realistic results.

133. The demographic-socio-economic models currently available for making population projections may not be suitable for determining population policy. While such models incorporate the feedback effects of economic and social change on population trends, they also incorporate additional assumptions about the nature of these relationships. Since these relationships are not well established, considerable caution should be exercised in interpreting the results of these models.

134. Frequently, socio-economic-demographic models must be tested on data bases which are inadequate. Under such circumstances, the results of the analysis cannot constitute a confirmation or rejection of the hypothesized relationships. In this case, it may be better to undertake a largely descriptive analysis which casts some light on the underlying processes rather than construct a model which cannot be tested.

135. Although it appears likely that demographers will continue to take account of past trends in their analyses for population projections, they should keep under active consideration the possibility of using demographic-socio-economic projection models. In the meantime, efforts are being made by the various model builders to develop better models whose data requirements could be met in most developing countries and which include policy instruments as variables. ESCAP should serve as the co-ordinator of such studies and should provide assistance in the installation of appropriate models in countries of the ESCAP region.

Chapter XI

THE USE OF SOCIO-ECONOMIC VARIABLES IN MAKING PROJECTIONS

136. In the past, assumptions about future trends in the components of population change have been of an arbitrary character. In order to satisfy planners' demands for more realistic projections, attempts have been made to identify those social and economic factors which have a significant effect on fertility, mortality and migration and use them in the formulation of sets of assumptions.

137. The importance of such variables can be illustrated in the case of Sri Lanka where age specific fertility rates have been influenced by trends in nuptiality as well as changes in marital fertility. These trends in turn are linked to trends in the rate of unemployment among young men. In making assumptions on future fertility trends, account must be taken of the effect of programmes designed to achieve full employment in the context of economic development.

A. Preparing fertility assumptions

138. Studies of the relations between social and economic variables and reproductive behaviour may be divided into two groups: (a) studies of the influence of short-term economic fluctuations on fertility, and (b) studies of the relationship between social and economic characteristics and fertility differentials. In the industrialized countries, fluctuations in nuptiality and fertility rates have been closely associated with short-run variations in such economic variables as employment, income and prices. However, the cyclical response of marriage and births to economic fluctuations has weakened. This may be due to the fact that increased access to contraception has reduced the importance of marriage deferment as a method of birth control during periods of recession.

139. Studies on cyclical fluctuations of fertility in developing countries are not currently available. In these countries, effective contraception is a relatively recent innovation which has not yet had a significant effect on fertility fluctuations. Desired family size is still large. This calls for a relatively narrow spacing of births, independent of economic considerations. As fertility starts to decline in these countries, the relationship between fertility and economic cycles may come to resemble that of the industrialized countries. However, it is unlikely that this could be of any significant assistance in fertility estimation. The possibility of forecasting business cycles with the necessary precision, and from them variations in nuptiality and fertility rates, is remote.

140. The association between fertility and socio-economic variables has been studied by correlating the personal characteristics of women or families with individual reproductive behaviour and the average characteristics of population aggregates with average fertility measures. Neither approach has, so far, been able to provide satisfactory, unequivocal and conclusive evidence on the determinants of reproductive behaviour.

141. Three criteria have been suggested for testing the suitability of socio-economic variables for estimating long-term future patterns and trends of fertility. First, the relationship between the socio-economic and the demographic variables must persist over time. Second, the socio-economic variables must be predictable or their effects not felt until a considerable time in the future. Third, the association between the socio-economic variables and fertility measures must be a close one.

142. On the basis of current findings, it appears that the relationships between these variables are not constant over time and space. For example, the relationship between income and fertility may be positive in the pre-transition stage, negative in the transition stage and positive again in the post-transition stage. Furthermore, the variables routinely used in these models are themselves difficult to predict with the degree of reliability required. Finally, most socio-economic variables currently used, such as income, education and unemployment, explain but a small part of the total variance of fertility levels. Therefore, attempts to explain fertility differentials between population aggregates by means of social and economic variables have yet to reach a point at which they could provide a tool for improved projections.

B. Preparing mortality and migration assumptions

143. The major socio-economic determinants of mortality patterns and trends are of two kinds: (a) those related to standards of living, and (b) those related to the provision of health services. A number of studies have explained a large proportion of the variance in age specific mortality levels in terms of these factors, but they are largely based on cross sectional data.

144. The prospects for introducing socio-economic variables into a system for forecasting internal migration appear more promising. Regional economic development, levels of job opportunities, levels of income and infrastructure should all have a close association with the movement of people. Moreover, time lags between the adoption of plans and their implementation in regional development programmes may be long enough to permit the use of these variables in population projections. Although the

models which have been developed to explain internal migration, such as the gravity model and models based on Markov Chains, have contributed to our understanding of the causes and long-run consequences of migration, they do not appear to be useful for improving prediction.

145. The failure of these models may be due to deficiencies of the basic data. Most of our information on internal migration is derived from censuses. If no specific questions were asked, such as the previous place of residence, estimates of population movement between two censuses would depend largely on the reliability of the estimation of natural growth in each area. This introduces a great deal of error into the estimates due to the quality of data and differentials in mortality and fertility levels among sub-national areas.

146. As more data become available from countries undergoing rapid economic and social change, it will be possible not only to test the existing relationships for their predictive validity and capacity, but also to further enhance the time-series approach and development of models which may be better suited for making projections. Until that time, the estimation of the future trends and patterns of the components of population change will largely depend on the demographic analysis of the past trends. This analysis has been greatly assisted by social and economic models explaining the role of external forces in the changes of demographic measures over time as well as variations of such measures among population aggregates. In this respect the search for economic and social determinants of demographic trends will continue to be of great importance.

Chapter XII

PROJECTIONS OF SUBNATIONAL POPULATIONS

A. Importance of subnational projections

147. While over-all targets for various components of the development plan may be centrally determined on the basis of national population projections, the detailed implementation of these plans depends on projections of population disaggregated by subnational areas or by special category of population.

148. Subnational areas might be states, districts, towns, urban-rural areas or other geographic divisions. The assessment of the future requirements of these areas for food, housing, education, medical, transport and other facilities would depend largely upon the population projections. Therefore, such projections are most useful for regional development planning within a country.

149. Subnational population projections serve as the basis for various aspects of physical planning, such as the design of human settlements and their supporting arrangements. They must also serve as a basis for various government policies designed to reduce disparities in levels of well-being, such as agrarian reform, rural development, and dispersal of industries. In this context, population projections might assist in evaluating alternative costs and benefits, or in the development of plans in greater geographic detail.

150. A number of subcategories of the population have come to be recognized as of special importance in demographic and socio-economic planning and, consequently, in making population projections. These categories include classification of the population by: (a) labour force status; (b) rural and urban residence; (c) agricultural and non-agricultural occupation; and (d) educational attainment. Rural and urban population projections are essential for planning future investments by both the Government and enterprises. Since agriculture constitutes the largest sector of the economy in most developing countries, projections of agricultural population are also essential for the preparation of development plans. The development of educational planning in recent years has led to a requirement for more detailed and comprehensive projections of school enrolment and total population by educational attainment. Planners have also found it useful to have projections of the number of households, since households rather than individuals are the primary units of consumption.

151. The task of making projections of subnational areas is more complicated than that of making national projections. At the subnational level, there are greater uncertainties with regard to future patterns of migration; data on fertility and mortality for subdivisions are often of lower quality or unavailable; and data may not be comparable owing to changes in boundary lines.

152. Problems associated with population projections in the subnational context vary according to the type of area. Political units, such as states, districts, and cities are subject to relatively few boundary changes, but subdivisions that represent non-administrative statistical classifications, such as urban areas together with areas classified by size, are frequently reclassified after analysis of population census data. Boundary changes and revised statistical classifications thus constitute another difficult factor which must be considered in the preparation of subnational projections.

B. Methods for making subnational projections

153. There is a wide variety of methods which can be used for making subnational projections. In contrast to national projections, both independent methods and methods dependent on the projection of another area may be used, internal migration must be accounted for and many more types of data are relevant. Among the methods available for making subnational projections, four techniques which should be considered are: the ratio method, the composite method, the density projection method and the multiple regression method. The ratio method calculates the ratio of the population of the local area to that of a larger area or the nation, and projects the trends of these ratios over time. The composite method makes independent projections of the three components of population growth: (i) rate of natural increase; (ii) growth due to changes in boundaries; and (iii) growth of population due to net migration. The density projection method assumes that the density of an area and hence its population cannot increase indefinitely. The multiple regression method relates the growth of subdivisions to certain social and economic variables through regression analysis.

154. Because it makes no demands for information on birth rates, death rates or migration rates, the ratio method is one of the most commonly used methods for making subnational population projections. The key problem in using this method is estimating the likely future trends in the ratio between the over-all population and its components.

155. The cohort component method is used in the preparation of most subnational population projections. This is due in part to the fact that planners often require age-sex specific projections. The cohort component

methods used in subnational projections range from the very simple to the highly complex. At one extreme, mortality and migration may be treated jointly; at the other, each migration component is handled separately by stating the specific assumptions.

156. The components of net migration and mortality are often combined and projected jointly, using population census cohort-change rates or migration-survival ratios. These rates represent the ratio of the population enumerated in a given age-cohort at one census to the population in the same age-cohort at a previous census. This method does not directly allow for the population cohort born during the intercensal (base) period and may be strongly influenced by errors of enumeration.

157. The cohort migration-survival method treats migration and mortality as separate components. Gross migration data, though useful, are often unavailable and if used would greatly complicate the methodology, therefore, net migration is most often used. Estimates of net migration, combining international and internal migration, can be readily derived by using residual techniques, such as the life table survivorship rate method or the census survivorship rate method, provided age-sex specific population data from consecutive appropriately-spaced censuses are available. Data on current previous-place-of-residence obtained from the census provide a suitable basis for projecting internal net migration, provided the country is not experiencing significant international migration.

158. Assumptions regarding future net migration for subnational areas should be based on the recent historical experience of the areas concerned. More realistic projections may be derived by projecting out migration and in migration separately rather than net migration, since variations in the levels of net migration are likely to be greater than either of its components.

159. Age-of-mother specific birth rates and age-specific survivorship rates (or death rates) may be projected for each area independently or as a ratio of the corresponding parent area rates. As age-sex specific birth and death statistics for small subnational areas are often not available and a large computational effort is required to produce independent projections, areas with approximately similar fertility and mortality experience are often grouped together and a common schedule of rates applied to each member of the group. In the case of mortality, which may experience minimal regional variation, the national schedule may be sufficient for projection purposes.

160. When preparing subnational projections by the component method, assumptions regarding fertility, mortality and migration rates for various areas might not be consistent with rates for the nation as a whole.

In such circumstances, if the discrepancy is not large, artificial consistency can be forced between the two by *pro-rata* or other methods. A better methodology is required for achieving such consistency.

161. The composite method can be used for obtaining population projections of a city or metropolitan area. An *a priori* knowledge of future development plans pertaining to the area would be most useful in making assumptions regarding the rates of growth of the components.

162. The density projection method is based on the assumption that, once the core of a city or metropolitan area attains a density close to the maximum, there is a slowing down of the growth rate. This may be due to the scarcity of land for dwelling units, traffic congestion, or pollution. Based on this assumption, mathematical models may be used for projection. The advantage of this method lies in its simplicity. It may be most useful in making projections needed for planning spatial development when detailed and accurate data with regard to other relevant variables are either not available or cannot be projected with accuracy.

163. Economic variables have been used in the context of a variety of projection techniques, including the ratio, component and correlation methods. Internal population movements are significantly affected by differentials in economic opportunity between subnational areas. Hence, a substantial alteration in the economic advantages of one area over another will have a significant effect on the future size and direction of migration flows. In such cases, projections of employment, *per capita* income, production and land use serve as a basis for making population projections.

164. Regression analysis techniques may be used to project the total population or merely the net migration component. The regression method should provide reasonable population projections for periods up to 10 years. However, due to the difficulty of predicting the behaviour of the explanatory variables, the regression method may not be suitable for long-term population projections.

165. Alternatively, subnational economic models or other analytical techniques may be used to forecast the economic prospects for each area. After giving separate consideration to the major sectors of the national economy, employment in various sectors of the local economy may be projected as a proportion of the corresponding national projections. Finally, local population is projected on the basis of future prospects for employment in the local area.

166. A limited type of component procedure may be used which depends on prior projections of employment or labour force. Projections based on this method may be made directly for entire populations or for separate

age groups. First, employment of the labour force is estimated, then net migration of the labour force, and net migration of the total population. Finally, the size of the total population is estimated.

167. Because of their heavy data requirements and the problem of demographic and economic interdependence, sophisticated projection techniques based on economic analysis are difficult to apply. An iterative technique must be used involving measurement of future labour force requirements and the degree to which these requirements can be met by the available population and net inward migration. A computer may be required to process age specific projections for a large number of areas, even if the simplest method is adopted.

168. The distinction between pre and post intervention is highly relevant in the case of subnational projections, since the planned distribution of housing and social infrastructure will greatly alter migration patterns. In this respect, a socio-economic demographic model on the subnational level would enable demographers to link projections and planning.

169. No single method for making subnational population projections is appropriate for all situations. The selection of a particular technique involves an element of judgement based on the quality and availability of the required data. For making short run projections, simple techniques of projecting migration, fertility, and mortality might be quite useful, yielding results as good as the more complex models presently available.

170. Regardless of the method selected, however, it would be desirable to take into account future development plans, such as the construction of roads, railway lines, dams and educational institutions. This kind of information, if available, would be most useful in preparing more realistic assumptions. In any event, greater use should be made of the recommendations contained in the report of the ESCAP Expert Working Group Meeting on Subnational Projections[17] and in the *Guidelines for Preparing Subnational Population Projections.*[18]

C. Projecting special populations

171. Subnational projections could be improved by a more refined analysis of population subgroups, taking into account the fact that some migration is the result of administrative decisions. Although there is no clear delineation between normal migrants and special populations, a number of

17/ "*Projections of populations of subnational areas:*" Report of a Working Group, 14-23 May 1969 (E/CN.11/897). Bangkok, 1969.

18/ United Nations, Asian Population Studies Series, No. 32 (in press).

examples of such populations may be cited. Special populations would include the military, students and institutional inmates. These subgroups are often characterized by an atypical age-sex composition or by unique stimuli for their migration. These special sub-populations can be projected more effectively from administrative plans than by a cohort component method. For this reason, the basic population should be projected in the normal manner and then adjusted for special populations.

172. Planners require projections of institutional or other special populations for determining requirements of various public facilities as well to estimate labour force participation rates. In the case of subdivisions where, special populations make up a significant portion of the total population demographers should supply planners with projections which exclude these non-appropriate populations.

173. An example of the treatment of special populations is found in the case of Hong Kong. To avoid the necessity of adjusting the age and sex structure of the population and the future number of births and deaths, all transients and armed forces in barracks (those who were not married) were deducted from the base population. At the end of the projection an identical number of these persons were added to the projected population by their original age and sex.

D. Projecting specific categories of the population

174. In addition to making subnational projections for areas, projections are also made for specific categories of the population. The labour force is normally projected by applying sex-age-specific activity rates to the projected population in each sex-age group. A variety of techniques is used in formulating assumptions about the pattern of future changes in activity rates. They include extrapolation of past trends, use of patterns from similar countries at a higher level of development and the use of socio-economic variables.

175. Rural and urban populations may be projected by the cohort component method, or by the ratio method. In using the cohort component method, the formulation of migration assumptions poses the most difficult problem. Projections of the agricultural population may be prepared by the extrapolation of past trends where data are available. They may be based on past trends in rural population or they may be linked to projections of the agricultural labour force.

176. Educational projections may be made by extrapolating past trends in enrolment rates and applying them to the projected age-sex distribution of the population. Enrolment rates, in turn, have been projected on the basis of analytical studies relating to changes in other socio-economic variables. Projections of households can be made by the headship rate method, simple extrapolation and by a number of other methods.

Chapter XIII

LONG-TERM ILLUSTRATIVE PROJECTIONS FOR PLANNING

A. Role of long-term projections

177. Although population projections over a span of 25 years are normally sufficient to meet the principal requirements of most development planning, there are a number of purposes for which planners require longer-term projections. Such long-term projections would be required in estimating the capacity of a water supply installation necessary to meet the future needs of a growing city. They would also be required when measures of population policy are being planned, since the effects of efforts to influence population trends may be felt only after the passage of a long period of time. Long-term projections would also be important for planning major irrigation projects, reafforestation programmes and major transportation and communication systems.

178. As a general rule, long-term projections are required when planners are primarily concerned with trends in population variables rather than in variations about those long-term trends. However, even the projection of trends beyond a period of 25 years may suffer from a high degree of uncertainty.

179. Long-term illustrative population projections for periods of 50 years or more provide planners with a rough indication of the ultimate size and age composition of the population. They help to emphasize the necessity of adopting suitable population programmes in the current plan period in order to achieve desirable demographic trends in the future. Such illustrative projections could enable policy-makers to determine the nature of changes in the various components of population growth necessary to achieve planned total population in the future. Thus long-term projections, combined with an understanding of the social, economic and environmental implications of the growth of population, could be most useful in the formulation of development policies.

B. Long-term projections of Thailand, Japan and The Republic of Korea

180. Thirty illustrative long-term projections for Thailand have been prepared by ESCAP.[19] These projections were derived from a combination of assumptions on nuptiality, ever married fertility and mortality. They demonstrated that large cumulative effects on the future growth of popula-

19/ This study will be published separately.

tion would result from small differences in the assumed fertility. The study thus illustrated the dynamic interrelationships that need to be considered between age at marriage, ever-married fertility rates, total population and its age distribution over a century.

181. By means of long-term projections of both national and subnational areas, it is possible to highlight three major demographic problems which must be faced by policy-makers in the ESCAP region. They are: (a) a considerable increase in total population; (b) a change in the age structure of the population; and (c) a maldistribution of regional population. All three of these problems can be illustrated in the context of long-term projections of Japan.

182. According to the latest population projection based on the medium assumption, the Japanese population will rise until it becomes nearly stationary in the first half of the twenty first century. Between 1970 and 2050 about 40 million persons will be added to the total population, thus aggravating basic problems in the areas of food, resources and environment.

183. Another aspect of Japan's movement to a stationary population is aging. Due to the lowering of the birth rate and the increase in life expectancy, the proportion of people aged 65 years and more in the total population will rise from 7.9 per cent in 1975 to 13.9 per cent in the year 2000. Such a rapid increase in the aged population will have a significant impact on the national economic and social situation.

184. Rural-urban migration has greatly increased and almost all the net migration has been absorbed in the three largest metropolitan areas of Japan. Furthermore, young people aged 15-24 years account for nearly half of the total migrants. Such rural-urban shifts of young people have a major influence on regional age composition. In some communities, it may not be possible to maintain basic activities essential to their socio-economic and cultural life, such as education and medical care, due to the loss of a large number of their young people. Clearly, the anticipated consequences of these population projections will affect many aspects of the economic, social and environmental situation in Japan over a long period.

185. In the Republic of Korea, population projections intended for use in the five-year plan were carried through the year 2040 in order to impress upon planners the necessity of implementing population control programmes now, if very grave problems a decade or more hence are to be avoided. Such projections provided a rough indication of the ultimate steady-state population implied by the given assumptions.

Chapter XIV
RECOMMENDATIONS

186. The Working Group on Population Projections concluded its substantive discussions by making the following recommendations to the countries of the region and the ESCAP secretariat.

187. Governments should establish continuing programmes for the preparation, evaluation and revision of population projections designed for use in development planning.

188. Population projections to be used for planning should be made by a co-ordinated effort of all agencies concerned so as to achieve consistency. These projections should be used by such agencies as a basis for their planning activities.

189. Planners and demographers should work in close co-operation to improve the preparation as well as enhance the use of projections. Planners should be involved in the formulation of assumptions and should supply to demographers information on policies, plans and targets.

190. Demographers should play an active role in development planning. This would include providing population projections which could serve for planning purposes. They should collaborate closely with planners in the preparation of projections.

191. Published projections should be given the widest possible dissemination in both technical and popular media, and the form of presentation should be tailored to the needs of users.

192. Efforts should be made to improve the quality and content of data for making population projections. This is especially important for making subnational projections. Studies should be undertaken on the costs of acquiring such data relative to the benefits to be derived from the increased utility of population projections.

193. More emphasis should be given to research on mortality, including development of improved methodology for studying mortality, and the revision or generation of model life tables applicable to countries of the ESCAP region.

194. Additional research should be conducted in fields related to estimating and projecting fertility. This should include further studies on the use of factors influencing fertility, such as nuptiality, contraceptive usage and age composition.

195. ESCAP should help co-ordinate the development of social and economic models which might be used for population projections and development planning. When models become available, ESCAP should

study their feasibility and provide for testing them and giving technical assistance.

196. Steps should be taken to further study problems of data and develop methodology for making subnational projections with a special focus on the estimation of future internal migration.

197. To assist planners in their selection of projections, demographers should provide analysis leading to qualitative measures, not necessarily in strict probabilistic terms, of the likely future realism of alternative projections.

198. ESCAP should compile, evaluate and catalogue available computer packages for making population projections including the requisite survey research and demographic analysis. The catalogue should be continuously updated and made available to potential users. ESCAP should also provide training and assistance to countries in the installation, modification and utilization of appropriate packages.

199. ESCAP should serve as coordinator of studies on socio-economic demographic models which could be used for making population projections in the context of development planning and should provide assistance in the installation of appropriate models in countries of ESCAP region.

200. Efforts should be made to improve data on the age distributions of base populations used in projections. In addition, improved methods of adjusting age distributions for errors in age reporting and differential undercount should be worked out.

201. Ways and means of providing more demographic data for development planning should be explored. Five-year censuses or intercensal sample surveys should be considered in this context. In addition, historical studies of changes in fertility, mortality and migration in countries within the region should be undertaken where data are available. In future, demographic data should be gathered and tabulated by social class as well as income stratum.

202. To encourage analysis of the interrelationship between social, economic and demographic variables within member countries, public-use sample tapes of population censuses should be made available. ESCAP should provide technical assistance and act as a central repository for the tapes.

Annex I

LIST OF DOCUMENTS

1. Review and assessment of existing population projections for Sri Lanka and their use in development planning (T. Nadarajah)
2. Estimation of the components of population change: Role of external variables (L.T. Ruzicka)
3. Quasi-stable population methods for adjusting age distributions in Indonesia (Alden Speare, Jr.)
4. Illustrative population projections for Thailand, 1970-2100 (K. Kobayashi)
5. On the use of projections in Swedish planning. Models of demographic-economic-social interrelations (Hannes Hyrenius)
6. The treatment of special populations in the cohort component method (Walter P. Hollmann)
7. A comparison of two component projection schemes for setting acceptor targets (Robert G. Potter)
8. Methodological problems and anticipated consequences of population projections for Japan (Hidehiko Hama)
9. Technical and conceptual problems in making population forecasts for development planning (Dai-Young Kim)
10. Assessing the impact of marriage and contraception in the projection of fertility (Jeanne Cairns Sinquefield)
11. The use of the LRPM models in making population projections for development planning (Joseph E. Quinn)
12. On the treatment of mortality in population projections (S.L.N. Rao)
13. Formulating assumptions for national projections: General principles (Tomas Frejka)
14. Some alternative techniques of subnational population projections: An evaluation and some suggestions (J.R. Rele and P.C. Saxena)
15. An evaluation of the method used in Hong Kong for the recent population projection exercise (B.N.H. Mok)
16. Review of population projection methodology, with comments on New Zealand practice (S. Kuzmicich)
17. Population projections and forecasts (L.T. Ruzicka)

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